DEKRA Mobility 4.0

Safely into the future mobility

Stan Zurkiewicz

Executive Vice President, DEKRA Group

Chief Regional Officer, DEKRA East & South Asia

BIRTH OF A LEGEND

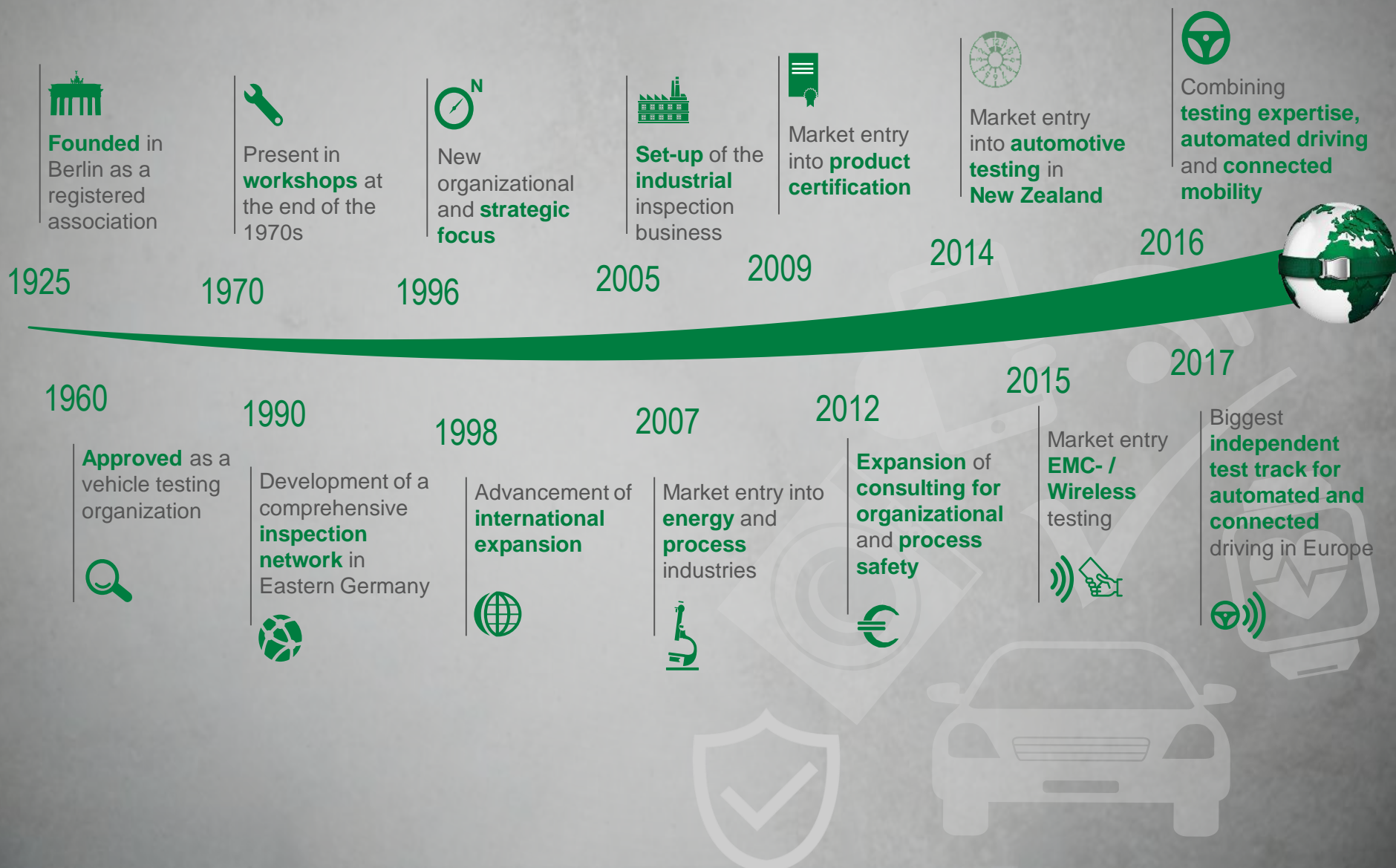|	
1925	Safety a statutory mission
€ 3.3 bn	Sales in 2018
46,000	Employees worldwide
306	Accreditations
25,000	System certifications
26,000,000	Vehicle inspections

GLOBAL PARTNER WITH SOLID ROOTS

DEKRA

1925
Founded in Berlin as a registered association

1970
Present in **workshops** at the end of the 1970s

1996
New organizational and **strategic focus**

2005
Set-up of the **industrial** inspection business

2009
Market entry into **product certification**

2014
Market entry into **automotive testing** in New Zealand

2016
Combining **testing expertise, automated driving** and **connected mobility**

1960
Approved as a vehicle testing organization

1990
Development of a comprehensive **inspection network** in Eastern Germany

1998
Advancement of **international expansion**

2007
Market entry into **energy** and **process** industries

2012
Expansion of **consulting for organizational** and **process safety**

2015
Market entry **EMC- / Wireless** testing

2017
Biggest **independent test track for automated and connected** driving in Europe

Significant additional momentum has been built up, and continues to do so

From 2016… … to tomorrow

Autonomous Driving

1-2% of vehicles sold are equipped with basic partial automation (L2) technologies

80% of the top 20 OEMs are planning to have AV L4+ by 2025

Shared Mobility

<1% of passenger miles travelled currently carried out using shared mobility

16% of customers already reported they would use shared mobility in the future

Connectivity

12% of cars equipped with embedded connectivity, generating revenues of less than $1.5 billion

Percentage of consumers ready to change car brand for better connectivity doubled in last 2 years

Electric Vehicle
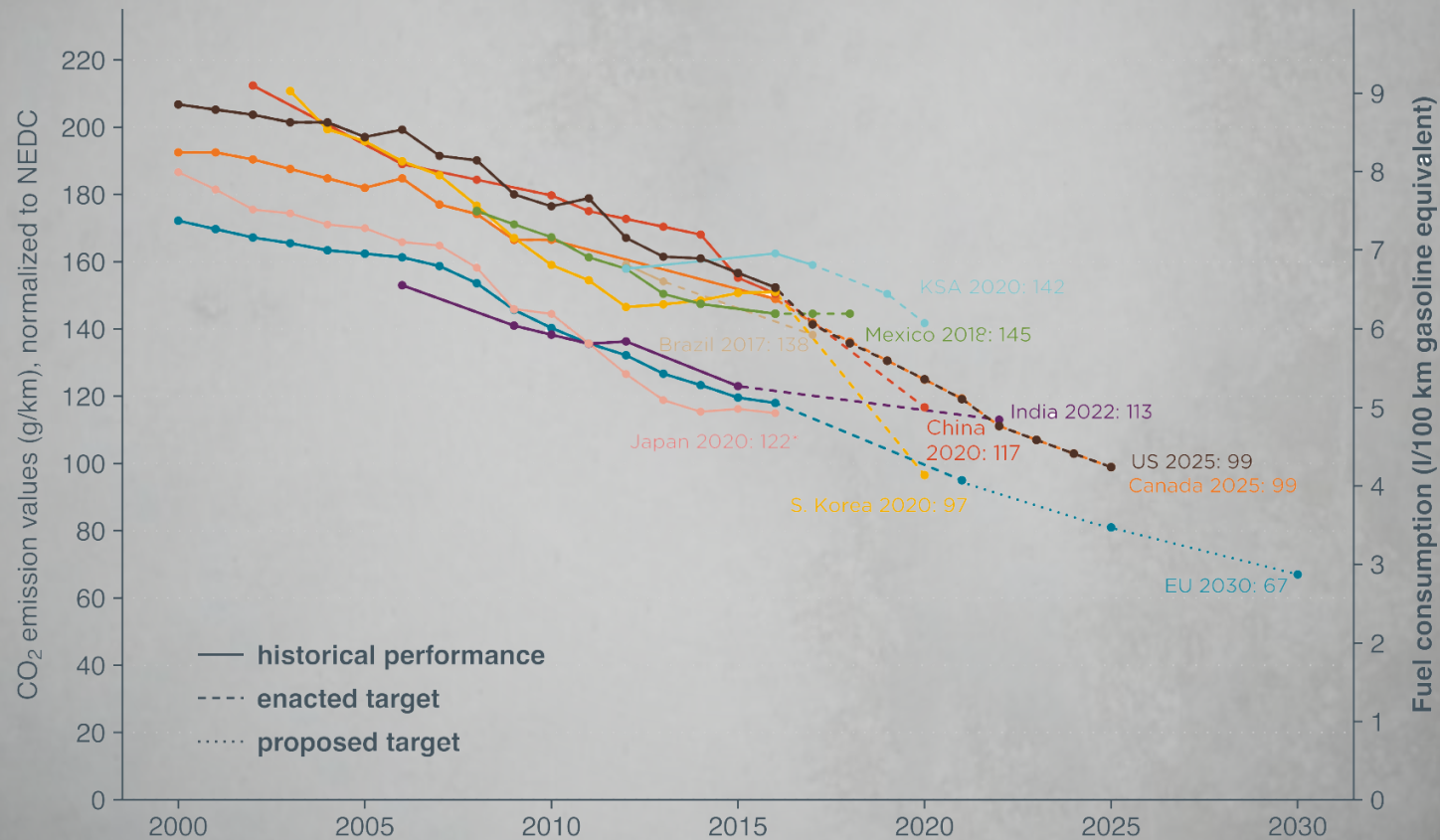
Less than 5% of vehicles sold have xEV powertrains

Over 50% of models announced until 2021 will have xEV powertrains

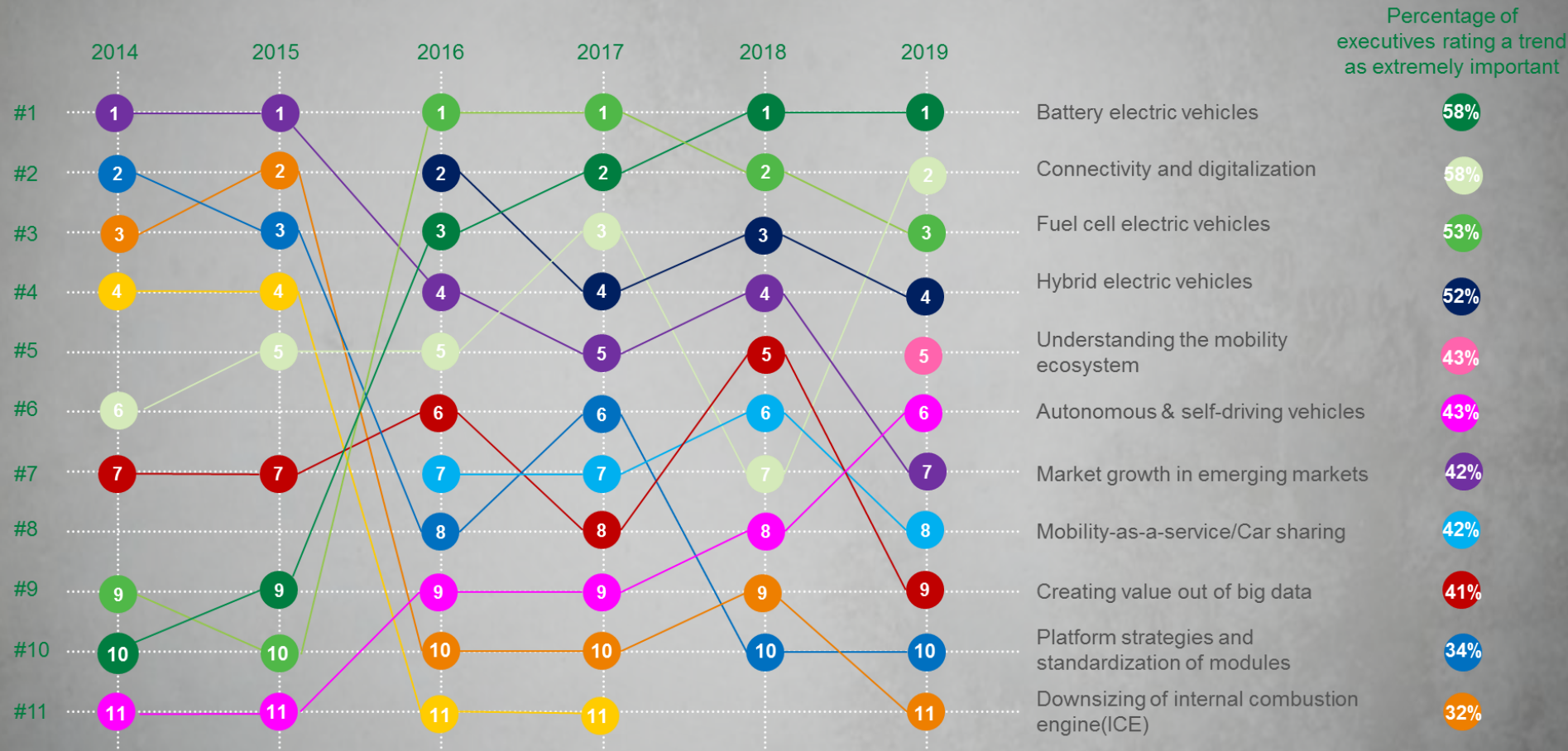Source: The Automotive Revolution Is Speeding Up, McKinsey&Company

The regulations influence the business decisions of major vehicle manufacturers around the world

DEKRA

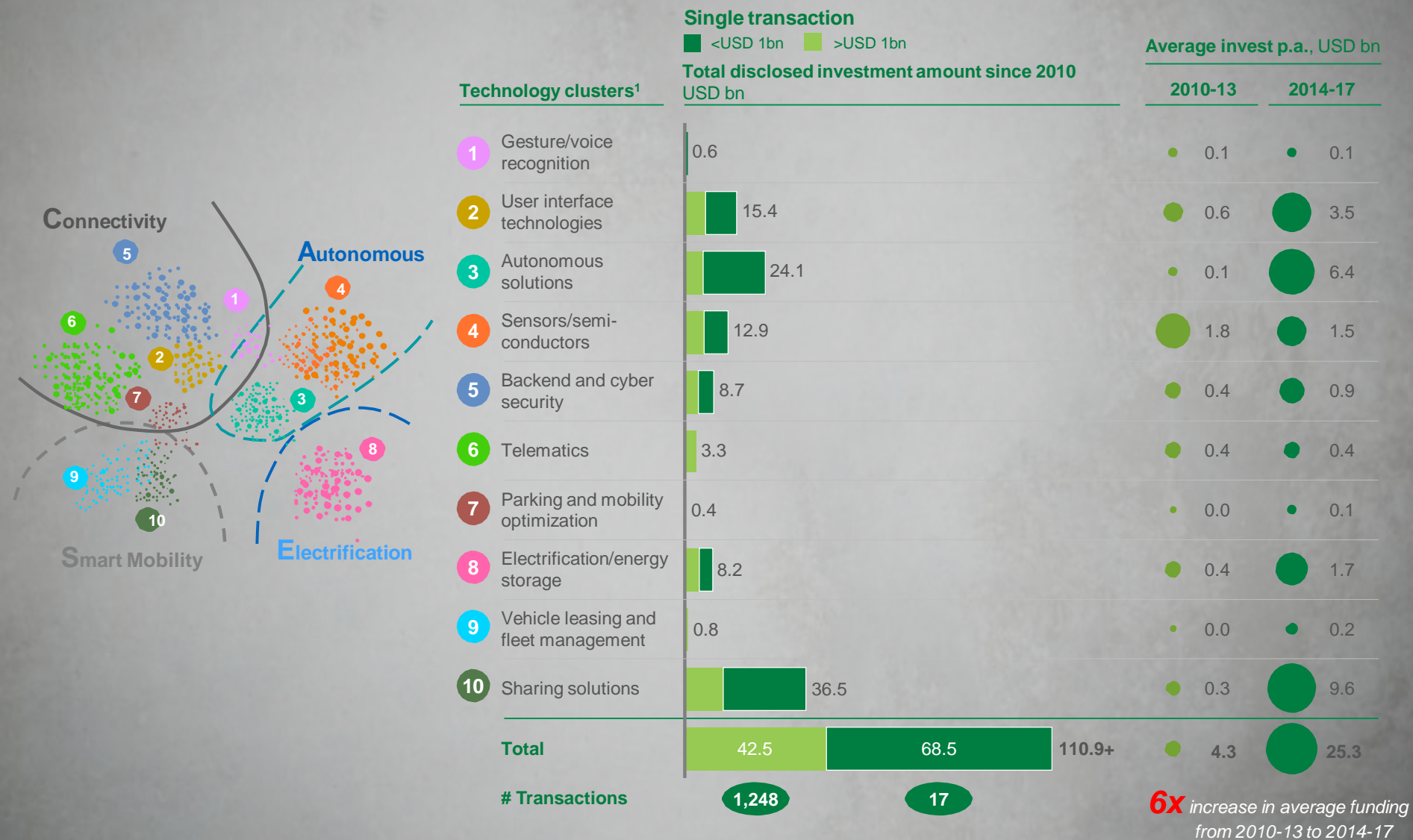**Passenger car CO2 emissions and fuel consumption, normalized to NEDC**

CO$_2$ emission values (g/km), normalized to NEDC

Fuel consumption (l/100 km gasoline equivalent)

KSA 2020: 142
Mexico 2018: 145
Brazil 2017: 138
India 2022: 113
China 2020: 117
Japan 2020: 122
US 2025: 99
Canada 2025: 99
S. Korea 2020: 97
EU 2030: 67

— historical performance
--- enacted target
···· proposed target

Regulatory pressure pushes awareness for electrification: BEVs are #1 key trend

DEKRA

	2014	2015	2016	2017	2018	2019		Percentage of executives rating a trend as extremely important
#1	1	1	1	1	1	1	Battery electric vehicles	58%
#2	2	2	2	2	2	2	Connectivity and digitalization	58%
#3	3	3	3	3	3	3	Fuel cell electric vehicles	53%
#4	4	4	4	4	4	4	Hybrid electric vehicles	52%
#5	5	5	5	5	5	5	Understanding the mobility ecosystem	43%
#6	6	6	6	6	6	6	Autonomous & self-driving vehicles	43%
#7	7	7	7	7	7	7	Market growth in emerging markets	42%
#8	8	8	8	8	8	8	Mobility-as-a-service/Car sharing	42%
#9	9	9	9	9	9	9	Creating value out of big data	41%
#10	10	10	10	10	10	10	Platform strategies and standardization of modules	34%
#11	11	11	11	11		11	Downsizing of internal combustion engine(ICE)	32%

Source: Global Automotive Executive Survey, KPMG 2018

The pace of overall investment in future mobility technology is accelerating greatly

DEKRA

Single transaction
■ <USD 1bn ■ >USD 1bn

Average invest p.a., USD bn

Technology clusters[1]

Total disclosed investment amount since 2010 USD bn

	Technology clusters[1]	Total disclosed investment (USD bn)	2010-13	2014-17
1	Gesture/voice recognition	0.6	0.1	0.1
2	User interface technologies	15.4	0.6	3.5
3	Autonomous solutions	24.1	0.1	6.4
4	Sensors/semi-conductors	12.9	1.8	1.5
5	Backend and cyber security	8.7	0.4	0.9
6	Telematics	3.3	0.4	0.4
7	Parking and mobility optimization	0.4	0.0	0.1
8	Electrification/energy storage	8.2	0.4	1.7
9	Vehicle leasing and fleet management	0.8	0.0	0.2
10	Sharing solutions	36.5	0.3	9.6
	Total	42.5 / 68.5 = **110.9+**	**4.3**	**25.3**

 # Transactions 1,248   17

Connectivity
Autonomous
Electrification
Smart Mobility

6x *increase in average funding from 2010-13 to 2014-17*

Autonomous driving will reform the automotive industry

Existing value chain

- OEM
- 0.5-tier supplier
- Tier 1 supplier (systems)
- Tier 2 supplier (modules or components)
- Tier 3 supplier (raw material, intermediate goods, or components)

New hub-and-spoke

- Tier-x supplier
- OEM
- IT supplier
- Online players
- Telecom companies
- Device manufacturers

Source: A.T. Kearney analysis
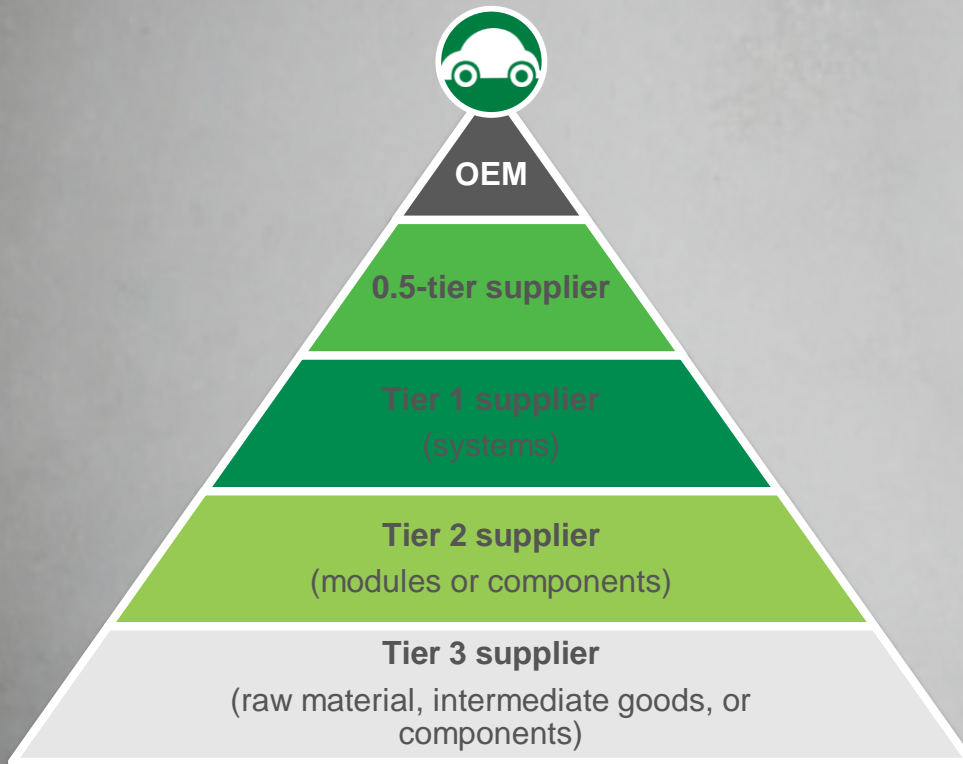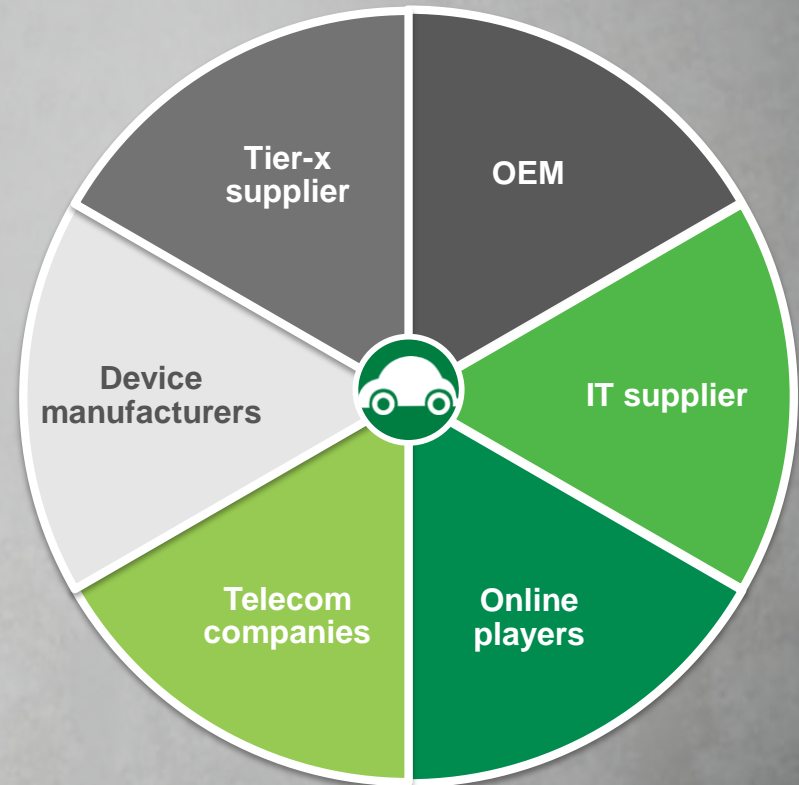
New hub-and-spoke companies will join forces to create powerful ecosystems

DEKRA

* non-exhaustive ecosystem

High-tech device manufacturers
Apple
Samsung
etc.

Software providers
SAP
Nokia
Huawei
Telefonica

Google
Microsoft
etc.

Traditional automotive players
Audi
Toyota   BMW
Mercedes-Benz
Renault Nissan
Faurecia   BOSCH
Volkswagen
etc

Telecom companies
T-Mobile
China Unicom
Vodafone
etc.

Online services
HRS
WhatsApp
Deezer
etc.
Audible
Pandora
Wechat

Huawei
Vinci
etc.

Infrastructure providers
Siemens

Social communities
Facebook
Foursquare
etc.
Twitter
Groupon

Source: A.T. Kearney analysis

Massive adoption of highly autonomous vehicles in China will likely start in 2027

DEKRA

Phase 1, ~2023

Low speed · High speed · Rural · Suburban · Urban · Bad weather · Peak hours · Nighttime

Technology ready and early adoption of constrained Level 4 technology

Phase 2, ~2027

Low speed · High speed · Rural · Suburban · Urban · Bad weather · Peak hours · Nighttime
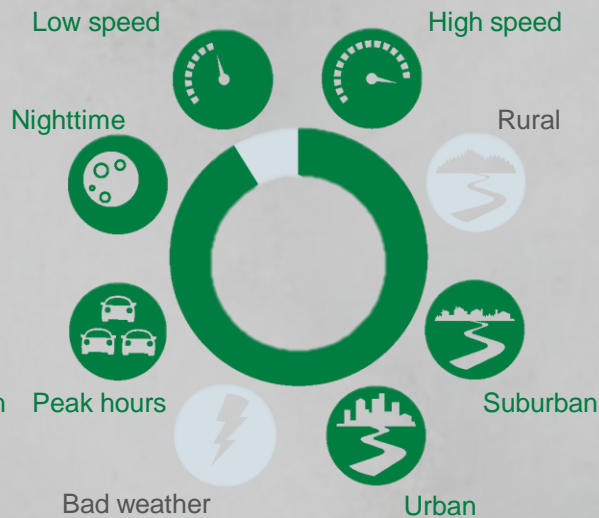
Start of mass commercialization of Level 4 technology

Phase 3, ~2032

Low speed · High speed · Rural · Suburban · Urban · Bad weather · Peak hours · Nighttime

Full adoption with penetration into rural areas

Source: How China will help fuel the revolution in autonomous vehicles, McKinsey&Company

DEKRA Klettwitz Technical Center
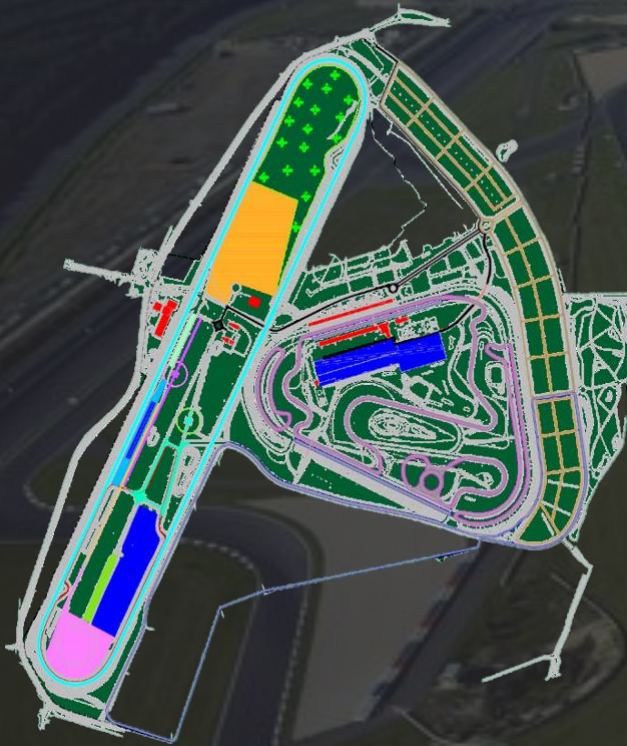
- Lausitzring race track

- DEKRA Technology Center (DTC)

- Build innovation and validation center for future mobility technology

- Invest more that 30 million dollars in the first stage of development of the new test compound

Protect And Support Connected And Automated Driving

5GAA C-V2X testing event successfully demonstrates exceptional level of interoperability at the automotive proving ground of host and 5GAA member DEKRA
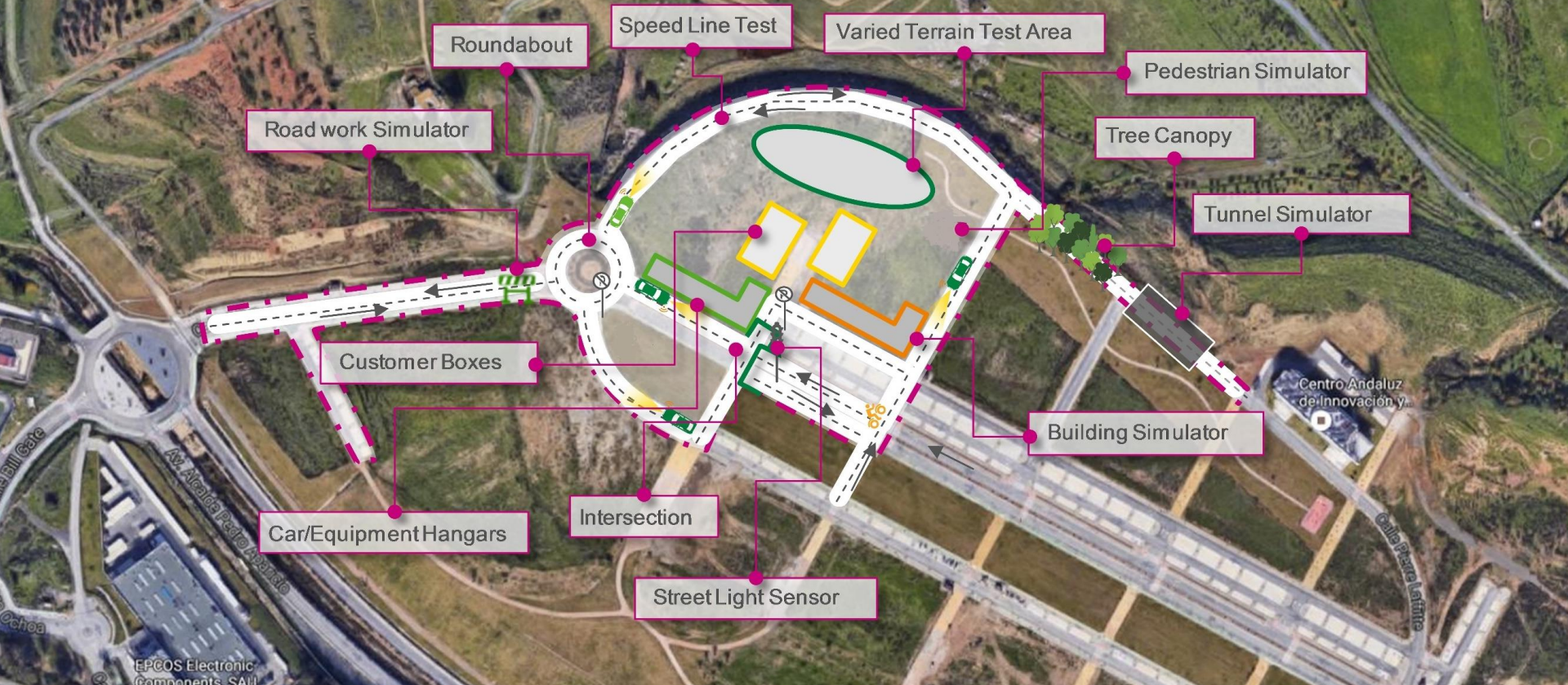
DEKRA R&D and Connected Vehicle Testing at Malaga - Infrastructure

- DSRC RSUs and OBUs from different manufacturers
- Variety of safety applications for OBUs and RSUs
- SDK for development of applications for OBUs and RSUs
- V2X development environment, capable of emulating several different OBUs and RSUs, as well as monitoring and validation of the message exchange
- Sniffer tools
- D-GNSS (base and mobile units)

- CAN bus monitoring
- Video registration
- Environment simulation equipment: traffic signs, traffic lights, road cones, vehicles and pedestrian simulators, …
- 2G, 3G and 4G coverage
- LTE-Adv-Pro and 5G coverage
- Support for cellular V2X (PC5)
- mobile traffic obstacles (guardrails, curbstones)
- mobile traffic management systems (signs, traffic

lights, toll bridges)
- And so on....
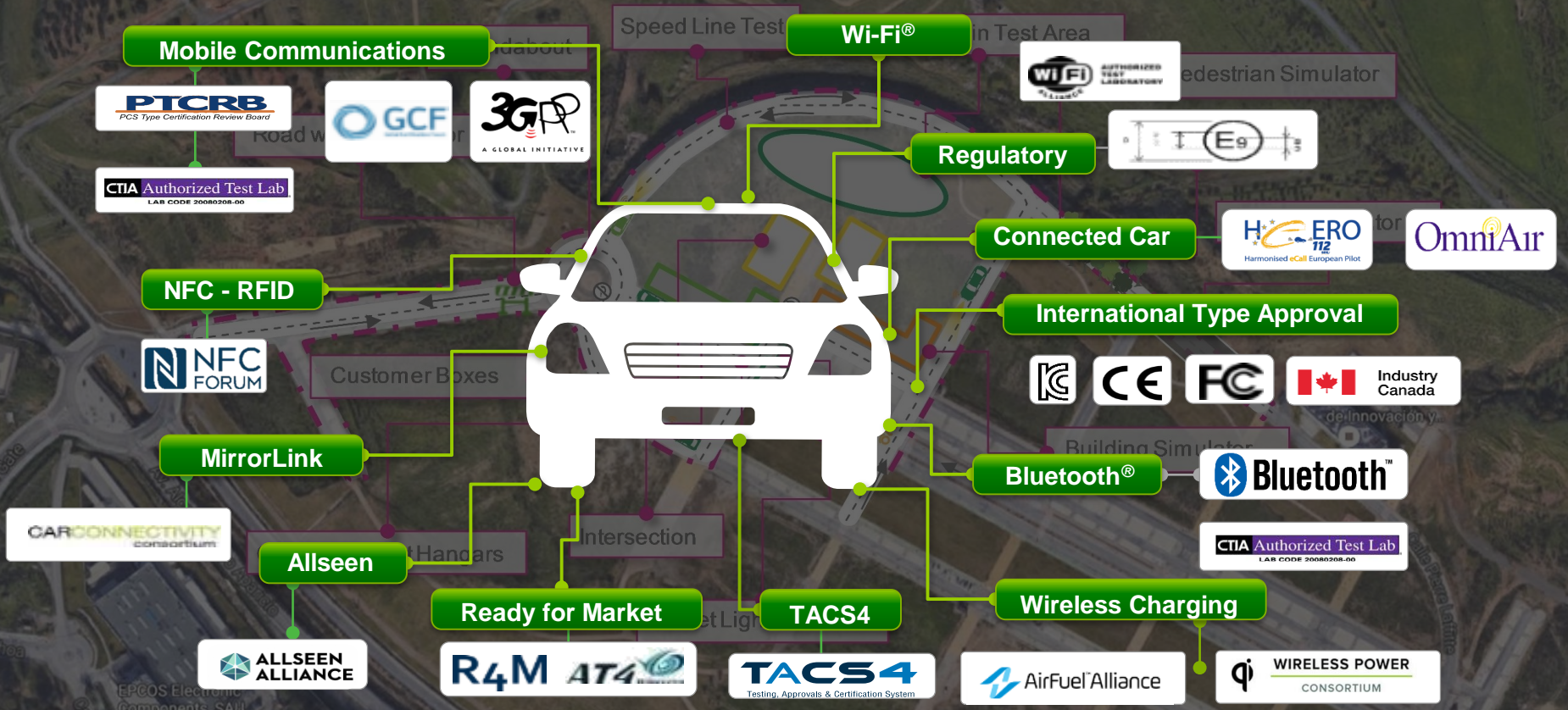
DEKRA R&D and Connected Vehicle Testing at Malaga

Most Complete Laboratory Testing Services for Connectivity in the Market

- DEKRA has a complete range of test equipment, accreditations and world class testing facilities to provide testing services for its international customer base.

- DEKRA is authorized and accredited laboratory for many wireless communication technologies.

DEKRA takes ambitious steps to realize Mobility 4.0

Test Track only

Automated Driving	Level 0 Driver only	Level 1 Assisted	Level 2 Partly Automated	Level 3 Highly Automated	Level 4 Fully Automated	Level 5 Driverless
	• Lane Change Warning • Blind Spot	• Lane Keeping Assistant • Park Assistant • Cruise Control	• Key Parking • Traffic Jam Assistant • Parking Assistant	• Driving on Motorway • Driving in a Traffic Jam	• Driving in Town • Valet Parking	• Fully Driverless Driving

Test Track & Laboratory

Connected Driving	Infotainment Applications	Electrical Vehicle Charging Service Control	Safety & Tracking Control	V2X Communications	Automatic Tolling Services	In Vehicle Wireless Control	Cyber Security
	• Smartphone Integration • Communication. & Hands free Calling • In Vehicle MiFi • In Vehicle TV	• Charge Points Networking • Paying & Billing	• Safety Tracking & eCall • Drive Assist. & Navigation • Maintenance & Support	• Road Hazard Signaling (RHS) • Signage Applications	• Highway Tolling • Parking Control	• Sensors / Actuators (TPMS, RKE) • Radars	• Functional Safety • Attack Protection • Information Privacy

Safety is where reliable power meets clean mobility

Battery

- Functional safety (Type approval, IEC 26262)
- Electrical safety (CB, EN 50604, ISO 18243, KEMA KEUR, IEC 62660)
- Performance testing (ISO 12405, ISO 18243, ISO 15118, IEC 62660)
- Development testing
- Validation testing

Charging

- Communication protocols (CHAdeMO, CCS)
- Market specific requirements (EV READY, SAE J1772, IEC 61851, UL 2202, UL 2594)
- Functional safety (IEC 26262, IEC 61508, IEC 61439, IEC 61851, IEC 62196)
- Electrical safety (KEMA KEUR, CB, ISO 26262, ISO 15118, IEC 61851, IEC 62752, UL 2231)
- Performance testing (IEC 62116)
- Wireless testing (IECEE 802.11p/WiFi, OCPP, 3G/4G/5G)
- Development testing
- Validation testing

Electronics & Components

- Type approval
- KEMA KEUR
- CE
- R10
- E1, E4
- ISO 15118
- Development testing
- Validation testing
- Other connected car services

DEKRA takes the lead in Mobility 4.0 momentum
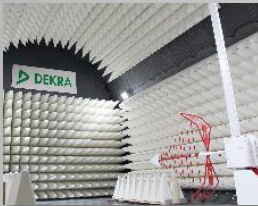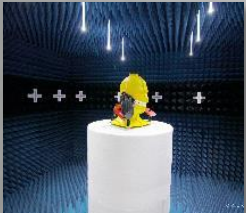
Unique model, combining **strong R&D** and early testing Test Area (Malaga, Spain) and **Large Production** Test Track (Klettwitz, Germany).

Configurable, to set up complex scenarios, for urban, non-urban or highway journeys, in a highly flexible way.

Proven expertise in automotive type approval, vehicle testing, EV testing and wireless & cellular testing and certification.

Strong focus in **Research, Technology Development and Innovation** in global markets.

Modern test labs, advanced test tools and professional experts to fulfill dynamic market demands.

Thank You!

DEKRA

Stan Zurkiewicz

Executive Vice President, DEKRA Group

Chief Regional Officer, DEKRA East & South Asia

Email: stan.zurkiewicz@dekra.com